DOCUMENT RESUME

ED 277 561 SE 047 656

TITLE	Indiana Science Proficiency Guide. Fall 1986 Draft.
INSTITUTION	Indiana State Dept. of Education, Indianapolis. Center for School Improvement and Performance.
PUB DATE	86
NOTE	29p.
PUB TYPE	Guides - General (050)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Educational Objectives; *Elementary School Science; Elementary Secondary Education; *Minimum Competencies; *Science Curriculum; Science Education; Science Instruction; *Secondary School Science; *State Curriculum Guides; *Student Educational Objectives
IDENTIFIERS	*Indiana

ABSTRACT

The Indiana State Curriculum Proficiency Guides were developed to provide educators and state decision makers with a framework for evaluating local curriculum and instructional efforts and also to serve as an interactive, self-renewing instrument that would provide the best current thought on student learning needs. This Fall, 1986, Draft of the guide for science programs contains four levels of goals/objectives/proficiency statements. The levels address specific proficiencies for primary, upper elementary, middle/junior high, and high school students. These statement levels include: (1) curriculum goals (consisting of six statements which served as the basis for the guide); (2) foundation proficiencies (identifying the initial science learning experiences which should be provided for students); (3) specific proficiency statements (specifying the capabilities that are prerequisite to the desired terminal ability); and (4) proficiency indicators (offering examples of observable behaviors that demonstrate that a proficiency has been acquired). Two high school populations are targeted with specific proficiencies. Functional proficiencies are listed for students who are unlikely to pursue any post-secondary education while academic proficiencies are described for students who will probably continue to be active, inquisitive learners throughout life. (ML)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED277561

INDIANA SCIENCE PROFICIENCY GUIDE

FALL 1986 DRAFT

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Joe Knight

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

CENTER FOR SCHOOL IMPROVEMENT AND PERFORMANCE

INDIANA DEPARTMENT OF EDUCATION

H. DEAN EVANS, SUPERINTENDENT

SE 047 656

Orientation to
the Fall 1986 Draft of the
Proficiency Guide for Science Programs
in Indiana Schools

PURPOSE OF PROFICIENCY GUIDES

The Indiana State Curriculum Proficiency Guides provide educators and decision makers with the best cooperative viewpoint of what every student should have the opportunity to learn in this state's elementary and secondary schools. Not only do the guides serve as benchmarks for judging local curriculum and instructional efforts, but they also provide the Legislature and others making state educational decisions with assistance in discerning the quality of the state's school program and in planning for its improvement.

EVOLVING NATURE OF THE PROFICIENCY GUIDES

The proficiency guides are not designed to become static documents but to be field interactive, self-renewing instruments that can continue to provide the best current thought on student learning needs. The guides are intended to become a computer managed data base which will be available to the Indiana educational community through a telephonic linkage system. This management system would also provide the State Department of Education with feedback concerning the content and utility of the guides. Until such a statewide computer network is a reality, it may be necessary to disseminate printout copies of the latest draft of one or more subject-area guides. The accompanying draft of science proficiencies is an example of such dissemination.

USE OF THE PROFICIENCY GUIDES IN TEXTBOOK ADOPTIONS

In the textbook adoption process, the proficiency guides can be used at both the state and local levels. State reviewers will examine each textbook in terms of whether it would support an instructional program promoting student acquisition of the proficiencies. Local curriculum/instructional committees can use the guides as a resource in evaluating and revising their program. Their resulting program plan can then be used to determine which state adopted textbook(s) would best support the local program goals and objectives.

Early drafts of the foundation proficiencies for social studies and mathematics were considered in evaluating textbooks in 1984-85 and 1985-86, respectively. The science proficiencies have reached a stage where they can be used in the manner suggested above. They have undergone enough field review that, although they have not been completely stabilized, they can be viewed as reflecting the best thinking regarding the current science literacy needs of students.

SPG/F86-1

DEFINITION OF TERMS

Proficiency

As used in the proficiency guides, the term proficiency means an open-ended performance statement that gives direction to the types of learning opportunities a student should experience in a given subject and or developmental level.

The accompanying document contains four levels of goal/objective/proficiency statements.

Curriculum Goals

Early in the proficiency effort, there was a need to develop a statement of what school programs should be providing the citizens of the 21st century who are currently in our classrooms. This statement took the form of six curriculum goal statements.

Foundation Proficiencies for Science

Using these curriculum goals as a frame of reference, foundation proficiencies, or subject-area goals, were developed for each curriculum area. The foundation proficiencies for science set forth, in general terms, those science learning experiences which should be provided during the student's thirteen years of schooling.

Specific Proficiency Statements

If students are to have opportunity to develop the abilities identified by the foundation proficiencies, there are certain specific capabilities that are prerequisite to the desired terminal ability. For science, specific proficiencies have been identified at the kindergarten/primary, upper elementary, middle school, and high school developmental levels.

Proficiency Indicators

There are certain overt performances which will give strong indication that a student has a given capability. Some of these have been identified by the proficiency indicators accompanying each specific proficiency. Therefore, the proficiency indicators should be considered as examples of observable behaviors that demonstrate that a specific proficiency has been acquired.

Functional and Academic High School Proficiencies

Even though the foundation proficiencies state the goals or terminal performances expected of high school graduates, it is necessary to describe these performances in a little greater detail in order for them to be effective tools for high school curriculum/instructional planning. Specific proficiencies have been developed for two high school student populations.

The functional high school science proficiencies address programs for the fifteen to twenty percent of the students who will take the two required years of science but who are unlikely to pursue any post-secondary education. These specific proficiencies identify those science based abilities needed to function productively in a scientific/technical society, i.e. the skills needed to be effective citizens, consumers, workers, and voters in the 21st century.

The academic high school science proficiencies address the needs of all other students. Although not all will pursue formal post-secondary study, most will continue to be active inquisitive learners throughout life. Thus, these proficiencies speak to the sciencing skills and understandings needed to make sense out of and be active participants in an information age.

Acknowledgements

The current (fall 1986) draft of the Science Proficiency Guide reflects the work of several task groups which have directly involved over thirty Indiana educators during the last two years. Through the Indiana Science Leadership and Resource Network, the product of these task groups has been reviewed by nearly 2000 teachers, administrators and university educators. Not all suggestions offered by the network could be directly incorporated into the science proficiency statements, but all suggestions were carefully considered as the developers strove to make the science proficiencies a most useful force for the revitalization of science education in Indiana's elementary and secondary schools.

Considerations for Local Schools
in Using the
Indiana Science Proficiency Guide

The local school personnel using the science proficiencies should be aware of their following characteristics.

Correlation of Foundation and Specific Proficiency

There has been no attempt to develop any form of one-to-one correspondence between the list of specific proficiencies and either the foundation proficiencies for science or the curriculum goals. Rather, each list of specific proficiencies was checked to determine if they included the types of learning needed in order for the foundation proficiencies to be realized by high school graduation. Some specific proficiency statements delineate learning experiences that contribute to two or more of the foundation proficiencies; in other cases two or more specific proficiencies may support a single foundation proficiency.

Prerequisite Objective to be Supplied

Although the specific proficiencies define some overall skill development sequences, many specific sub-skills are omitted. For example: both sets of high school proficiencies address problem-solving and decision-making, but at no point are the strategies, or steps, of problem-solving and decision-making specified. This void occurs since the specific proficiencies address only terminal abilities at each developmental level. Assembling an appropriate sequence of coursework and daily learning experiences for students to acquire the proficiency is the proper domain of curriculum designers and classroom teachers.

Proficiency Indicator List Not Comprehensive

The indicators included in the accompanying document are only sample lists. Since the examples are not all inclusive, school corporations and classroom teachers may find it helpful to supplement these lists. Particularly at the high school level, teachers of a specific science course are encouraged to develop a list of indicators describing the learning experiences that their course should promote.

Specific Proficiencies Are Developmental

Even though not all developmental steps are identified by the proficiencies, they do incorporate several developmental sequences as the specific proficiencies progress through the various developmental levels. Therefore, teachers at each level need to review the specific science proficiencies for the preceding levels in order to design appropriate refresher or remedial experiences while eliminating overly redundant student experiences.

SCIENCE PROFICIENCY GUIDE
FALL 1986 DRAFT

CURRICULUM GOALS

Early in the process of developing the Indiana State Curriculum Proficiency Guides, there was a need to identify the learning opportunities that today's students should be provided if they are to be adequately prepared for 21st century citizenship. These learning needs were stated in the form of six curriculum goals. These goal statements were initially a summary of General Principles for School Programs adopted in 1985 as part of the Indiana Admistrative Code [511 IAC 6-1-2.1] by the Indiana State Board of Education. These initial goal statements were then compared with several recent statements of the learning needs of children and the educational needs for 21st century society. The resulting Curriculum Goals, that were used as the base document for the development of the Indiana Science Proficiency Guide, are:

Students in Indiana schools should be provided learning experiences which permit them to:

- master skills necessary to gather and process information and to communicate information and ideas efficiently.
- acquire and use content as the vehicle for development of the creative and critical thinking necessary for making informed decisions and for continued learning.
- develop the attitudes, ethical principles, and artistic values necessary to live a responsible, productive, and physically satisfying, self-fulfilling life.
- gain the understanding of their own and other cultures needed for them to become involved global citizens.
- acquire the skills necessary to be successful in their chosen life roles.
- develop and use skills necessary to manage the changing conditions associated with social living.

INDIANA STATE BOARD OF EDUCATION GOAL

In February, 1986, the State Board reinforced the emphases of these curriculum goals in adopting six major goals for education in Indiana. Goal 6 states:

> "Ensure That the Public School Is Responsive to the Needs of Students
>
> "The intent of this Goal is to provide the leadership and, where appropriate, standards and regulations which ensure that Indiana's children receive an education that will prepare them for a productitve life in a pluralistic and changing global society. To achieve this Goal the Board will:
>
> - Ensure continuity in the learning experience as children progress from one course to another, and one grade level to another, and ensure that learning objectives and expected competencies of each grade level are clearly articulated and understood by students, parents, and community.
> - Integrate communication, critical thinking, decision making, problem solving, and study skills into the teaching and learning process.
> - Ensure that subject matter taught in the public schools prepares children for a productive life in a pluralistic and changing global society.
> - Provide sufficient flexibility to curriculum and teaching methods to ensure that all children, regardless of individual differences, have an equal opportunity to learn and are challenged to reach the highest level of achievement consistent with their ability.
> - Provide students through the school curriculum, co-curricular and extra-curricular activities the opportunity to acquire the knowledge, skills, habits, and attributes that prepare them to become productive members of society.
>
> "Achievement of this Goal will be indicated when the curriculum of all public schools meets the stated objectives."

FALL 1986 DRAFT [08/13/86]

THE PHILOSOPHY OF THE SCIENCE PROFICIENCIES

The Foundation Proficiencies for science were developed by asking, "What unique, but not necessarily exclusive, contributions can science learning experiences make to the kind of education described by these various educational and curriculum goal statements?" In answering this question, it became clear that science education, designed for the 21st century citizens, must focus on the science process skills of information access and retrieval, critical thinking, communication, and the use of scientifically generated theories and principles in problem solving and decision making.

This emphasis on the skills and strategies does not nullify the need for knowledge of science facts, concepts, theories, laws, and principles; rather it highlights the need to allow students to experience the utility of this knowledge, even during their initial exposure to it. Although the foundation and specific proficiencies are stated in terms of skill development, the proficiencyiy indicators incorporate science content. As school corporations and classroom teachers flesh-out the proficiencies with additional indicators appropriate to local and individual student needs, the role of science content will become more apparent. However, science programs, which do not provide students with opportunities to realize and become proficient in applying the utility of scientific and technological knowledge, will be of little value to the students.

FOUNDATION PROFICIENCY LIST 060000

THE FOUNDATION PROFICIENCIES FOR SCIENCE

Students in Indiana schools should be provided science learning opportunities which will allow them to:

1. use data gathering and organization skills to identify and investigate questions and assumptions.

2. apply communication skills to exchange self-generated and acquired knowledge.

3. use the major ideas of science in rational, creative thinking.

4. appreciate the tentative nature of empirical knowledge.

5. appraise technological applications of scientific discoveries in terms of their ethical effects.

6. demonstrate competence and confidence in applying the knowledge, processes, and attitudes of science in making informed decisions.

FALL 1986 DRAFT [08/13/86]
SPECIFIC PROFICIENCY LIST 061000

SPECIFIC PROFICIENCIES FOR KINDERGARTEN/PRIMARY SCIENCE

Through science learning opportunities provided in the kindergarten and primary grades, students should develop the ability to:

1. use the five senses to gather and collect data.
2. sort, group, or arrange objects, systems, ideas, or events on the basis of similarities, differences, or a suggested standard.
3. use simple instruments to describe observations more accurately.
4. infer possible explanations of conditions or changes.
5. use data to forecast or predict future events or conditions.
6. explore things and events to better understand the world.
7. identify ways science and technology affect their lives.
8. communicate scientific and technological information and ideas.

SPECIFIC PROFICIENCY LIST 062000

SPECIFIC PROFICIENCIES FOR UPPER ELEMENTARY SCIENCE

Through science learning opportunities provided in the upper elementary grades, students should develop the ability to:

1. use basic investigation skills in examining new events and ideas.
2. select and use reliable, relevant sources of information.
3. identify relationships between independent and dependent variables.
4. invent and test "if...then" speculations.
5. identify key persons and episodes in the development of science and technology.
6. modify concepts because of newly acquired information.
7. forecast how the changing of one factor can alter the environment.
8. use a variety of skills to communicate scientific and technological information.

SPG/F86-8

SPECIFIC PROFICIENCY LIST 063000

SPECIFIC PROFICIENCIES FOR MIDDLE/JUNIOR HIGH SCHOOL SCIENCE

Through science learning opportunities provided in middle/junior high school, students should develop the ability to:

1. use concrete data gathering and investigating skills in examining interactions and concepts.
2. assess sources of scientific and technological information for their validity and utility.
3. analyze natural and technological systems.
4. propose generalizations (principles, theories, etc.) that unify a variety of observations and data.
5. use scientific and technological information to propose solutions to human problems and social issues.
6. define the role that key episodes in the history of science and technology have had in human understanding and management of nature.
7. revise ideas about how things work when additional valid information is presented.
8. describe how applications of scientific discoveries have affected mankind and the environment.
9. communicate scientific and technological information.

SPECIFIC PROFICIENCY LIST 064100

SPECIFIC PROFICIENCIES FOR FUNCTIONAL HIGH SCHOOL SCIENCE

Through science learning opportunities provided in high school, students planning limited post-secondary education should develop the ability to:

1. use acquired information processing skills to investigate new ideas and problems.
2. develop qualitative and quantitative classification schemes.
3. access dependable scientific and technological information.
4. use the laws, theories, and principles of science to organize data and information.

SPECIFIC PROFICIENCIES FOR FUNCTIONAL HIGH SCHOOL SCIENCE (CONT.)

Through science learning opportunities provided in high school, students planning limited post-secondary education should develop the ability to:

5. demonstrate a willingness to re-evaluate existing ideas as a result of obtaining new information.

6. use scientific and technological information in making decisions about personal concerns.

7. cite examples of the interdependence of science, technology, and society.

8. communicate technological ideas in written and verbal formats.

SPECIFIC PROFICIENCY LIST 064200

SPECIFIC PROFICIENCIES FOR ACADEMIC HIGH SCHOOL SCIENCE

Through high school learning opportunities provided in the sciences, students planning post-secondary study should develop the ability to:

1. safely use appropriate technology to extend the senses.

2. access reliable information from any area of pure and applied science.

3. use empirical data to formulate, support, or question generalized statements, including the laws, theories, and principles of science.

4. apply the scientific knowledge and processes to the resolution of complex problems and issues.

5. recognize that scientific knowledge is tentative, self-corrective, and visionary.

6. use scientific and technological information in developing personal viewpoints, societal decisions, and career plans.

7. illustrate the interdependence of science, technology, and society.

8. communicate information on scientific and technological issues.

SPECIFIC PROFICIENCY STATEMENTS AND PROFICIENCY INDICATORS KINDERGARTEN/PRIMARY SCIENCE

Through science learning opportunities provided in the kindergarten and primary grades, students should develop the ability to:

1. use the five senses to gather and collect data.

   Sample Indicators:

   a. discriminate among sets on the basis of observable properties such as texture, size, shape, color, weight, or smell.
   b. identify sounds on the basis of loudness, pitch, or duration.
   c. describe objects in terms of hotter or colder.
   d. discriminate among substances that are solids, liquids, or gases.
   e. describe foods on the basis of taste.

2. sort, group, or arrange objects, systems, ideas, or events on the basis of similarities, differences, or a suggested standard.

   Sample Indicators:

   a. sort plants from animals based upon given standards.
   b. sort living from non-living based upon given standards.
   c. classify objects or events in the natural world based upon a selected similarity or difference.
   d. select objects that may have further use from a group of objects that have served the purpose for which they were designed.

3. use simple instruments to describe observations more accurately.

   Sample Indicators:

   a. quantify size in three dimensions.
   b. measure objects in order to compare their size, weight, temperature, direction, or location.
   c. use different types of lenses to observe objects.
   d. describe different sounds after listening to them with a stethoscope.

Through science learning opportunities provided in the kindergarten and primary grades, students should develop the ability to:

4. infer possible explanations of conditions or changes.

   Sample Indicators:

   a. describe seasons with respect to rotation and revolution of the earth around the sun.
   b. explain night and day in terms of the earth's rotation.
   c. suggest explanations for fossils.
   d. identify possible sources of various kinds of energy.
   e. suggest explanations for the forms of matter.
   f. propose explanations for physical or chemical changes in matter.

5. use data to forecast or predict future events or conditions.

   Sample Indicators:

   a. use past observations to suggest changes in the weather.
   b. predict anticipated seasonal events.
   c. suggest cycles in plants, animals, and natural events.
   d. predict interaction of physical substances based upon previous experiences.

6. explore things and events to better understand the world.

   Sample Indicators:

   a. compare observations, inferences, and conclusions with those of classmates.
   b. plan simple experiments to verify data or statements.
   c. propose an alternative for an ineffective solution.
   d. make predictions from observed data.
   e. describe the interdependence of people and their environments.
   f. construct a 3-dimensional model of an object that they have measured or found the dimensions for.

Through science learning opportunities provided in the kindergarten and primary grades, students should develop the ability to:

7. identify ways science and technology affect their lives.

   Sample Indicators:

   a. name several man-made products that pollute or reduce pollution.
   b. list concerns about water pollution.
   c. use pictures to illustrate a variety of land uses.
   d. name ways various sounds can affect their peace and health.
   e. describe how science and technology has improved our ability to move about, communicate, live in more confortable environments.
   f. list discoveries that have improved daily life.
   g. use technology to expand their investigative skills.
   h. identify ways to improve the environment in the local community.

8. communicate scientific and technological information and ideas.

   Sample Indicators:

   a. describe orally a living or non-living system.
   b. describe changes in characteristics of living or non-living systems or events over a period of time.
   c. construct graphs to describe space/time occurrences.
   d. interpret data from graphs.
   e. use maps to give directions.

SPECIFIC PROFICIENCY STATEMENTS AND PROFICIENCY INDICATORS UPPER ELEMENTARY SCIENCE

Through science learning opportunities provided in the upper elementary grades, students should develop the ability to:

1. use basic investigation skills in examining new events and ideas.

   Sample Indicators:

   a. observe, measure, and record changes using a variety of measuring devices.
   b. describe new experiences in terms of known information.
   c. estimate quantitative observations.
   d. classify objects based upon observation and/or manipulation.

2. select and use reliable, relevant sources of information.

   Sample Indicators:

   a. identify reliable sources of scientific information.
   b. discriminate pertinent and non-pertinent information in journals or other scientific sources.
   c. evaluate information in terms of its adequacy and the reliability of the source.

3. identify relationships between independent and dependent variables.

   Sample Indicators:

   a. demonstrate ways to change the speed of an object.
   b. explain daily and seasonal changes in terms of the earth's rotation and tilt.
   c. identify ecological factors that affect growth rates.
   d. describe an environmental problem in terms of cause and effect.
   e. demonstrate that there is an equal and opposite reaction to any force exerted on an object.
   f. demonstrate competition of plants and animals for basic needs.
   g. cite examples of regularity and order in nature.

Through science learning opportunities provided in the upper elementary grades, students should develop the ability to:

4. invent and test "if...then" speculations.

   Sample Indicators:

   a. construct models to describe the origin of present earth structures.
   b. predict possible results of introducing a new predator into a community.
   c. design a device to accomplish a task then build and test the device or a scale model of it.
   d. invent and test one or more models that might explain the volume, density, and flow characteristics of the states of matter.
   e. develop and test a solution to a real or imaginary problem.
   f. test predictions about chemical reactions, geologic change, appearance of offspring, environmental problems, natural events, etc.

5. identify key persons and episodes in the development of science and technology.

   Sample Indicators:

   a. cite people and discoveries which have affected current scientific thought.
   b. identify the developmental steps that led to a given technology.
   c. describe how scientific discoveries and technological applications have affected the quality of life.

6. modify concepts because of newly acquired information.

   Sample Indicators:

   a. design a test to provide additional information about a question.
   b. gather new evidence about the environment.
   c. propose alternate methods for doing routine activities.
   d. demonstrate a better understanding of the earth after studying the rock record.
   e. use new sources of information to re-examine previous learning and experimental conclusions.

Through science learning opportunities provided in the upper elementary grades, students should develop the ability to:

7. forecast how the changing of one factor can alter the environment.

   Sample Indicators:

   a. use data to show that a particular pollutant may alter the environment.
   b. predict how the altered use of one resource may affect the demand for other resources.
   c. chart how population growth affects renewable and non-renewable resources.
   d. develop a model that relates population increases to pollution, space, or limited resources.
   e. project how eliminating a common disease could change the quality of life worldwide.

8. use a variety of skills to communicate scientific and technological information.

   Sample Indicators:

   a. utilize graphs to communicate space/time events.
   b. describe procedures of investigation.
   c. explain a specific application of science to technology.
   d. prepare reports containing observations and conclusions.
   e. construct diagrams or models to depict such things as the solar system, life cycles, weather cycles, etc.

SPECIFIC PROFICIENCY STATEMENTS AND PROFICIENCY INDICATORS MIDDLE/JUNIOR HIGH SCHOOL SCIENCE

Through science learning opportunities provided in middle/junior high school, students should develop the ability to:

1. use concrete data gathering and investigating skills in examining interactions and concepts.

   Sample Indicators:

   a. classify objects or events using observed similarities and differences.
   b. measure the size, mass (weight), time, and temperature of objects in appropriately identified units within an acceptable degree of accuracy.
   c. use measurements to calculate quantities such as velocity, density, acceleration, temperature gradient, electrical resistance, growth rates, energy, biomass.
   d. recognize the tentative nature of scientific data.
   e. design and conduct controlled experiments to test the validity of their generalizations.

2. assess sources of scientific and technological information for their validity and utility.

   Sample Indicators:

   a. distinguish fact from opinion.
   b. select appropriate sources of scientific and technological information.

3. analyze natural and technological systems.

   Sample Indicators:

   a. identify and describe the function of the parts of living systems.
   b. identify the components of nonliving systems (electrical circuits, energy cycle, water cycle, chemical reactions, nitrogen cycle).
   c. identify phenomena that cause changes in earth conditions.
   d. identify outstanding characteristics of celestial phenomena.
   e. determine why a machine or an appliance is not working.

Through science learning opportunities provided in middle/junior high school, students should develop the ability to:

4. propose generalizations (principles, theories, etc.) that unify a variety of observations and data.

   Sample Indicators:

   a. recognize relationships between/among measured variables.
   b. propose relationships between matter (mass), forces, motion, and energy (work) from personally collected or other available data.
   c. propose a concept or principle about an organism which explains its behavior.

5. use scientific and technological information to propose solutions to human problems and social issues.

   Sample Indicators:

   a. use nutrition principles to develop weekly menus for oneself and family.
   b. use concepts of mass and energy conservation to design waste management systems for home, school, and community.
   c. discuss the pros and cons of various recreational activities in terms of their effects on personal health, environment, and energy supplies.

6. define the role that key episodes in the history of science and technology have had in human understanding and management of nature.

   Sample Indicators:

   a. identify how medical discoveries have affected human health.
   b. trace how development of energy resources has changed the course of history.
   c. identify the effects of technology on the growth of communications.
   d. describe how mankind's view of his relationship with the universe has changed over time.

Through science learning opportunities provided in middle/junior high school, students should develop the ability to:

7. revise ideas about how things work when additional valid information is presented.

   Sample Indicators:

   a. continue to collect data relevant to food choices, recreational habits, etc.
   b. incorporate scientific developments to modify personal views about the nature of the manmade and natural environment.
   c. evaluate conditions in their environment which have affected the quality of life.

8. describe how applications of scientific discoveries have affected mankind and the environment.

   Sample Indicators:

   a. contrast the environmental effects of using agricultural pesticides with their qualitative and quantitative effects on food production.
   b. compare the effects of automation on product quality and its effects on worker self-concept.
   c. contrast the impact of medical knowledge on the economic and ethical quality of life.
   d. identify new career opportunities that result from application of recent scientific discoveries.

9. communicate scientific and technological information.

   Sample Indicators:

   a. display data in meaningful tables and graphs.
   b. design a model to predict future events or conditions.
   c. translate chemical equations into meaningful verbal sentences.
   d. prepare and present a report that includes supporting material.

SPECIFIC PROFICIENCY STATEMENTS AND PROFICIENCY INDICATORS FUNCTIONAL HIGH SCHOOL SCIENCE

Through science learning opportunities provided in high school, students planning limited post-secondary education should develop the ability to:

1. use acquired information processing skills to investigate new ideas and problems.

   Sample Indicators:

   a. make distinctions between observations, predictions, and inferences.
   b. group ideas, facts, or concepts in a way they can be used in problem solving.
   c. measure length, mass, volume, time, temperature, and pressure using proper instrumentation.
   d. identify the interrelationships of cells to living systems.
   e. graph changes over a period of time.
   f. recognize or describe a chemical reaction.
   g. explain how energy is transformed, transferred, or stored in natural and technological systems.

2. develop qualitative and quantitative classification schemes.

   Sample Indicators:

   a. order a collection of objects or events using a systematic pattern.
   b. classify non-living and living materials by obvious characteristics.
   c. draw a concept map (flowchart or schematic) to explain relationships between simple concepts.

3. access dependable scientific and technological information.

   Sample Indicators:

   a. develop criteria for discerning reliable scientific and/or technological information.
   b. select information sources that are useful in researching a technological problem.
   c. indentify information sources related to a personal problem.

Through science learning opportunities provided in high school, students planning limited post-secondary education should develop the ability to:

4. use the laws, theories, and principles of science to organize data and information.

   Sample Indicators:

   a. cite examples which show that life, physical, chemical, and geologic processes tend toward equilibrium.
   b. use appropriate laws to explain relationships between variables; e.g.: velocity/distance/time, etc.
   c. explain atmospheric changes using temperature and pressure laws.
   d. relate the effects of carrying capacity, food supply, and prey-predator relationships on population fluctuations.
   e. explain how heredity and environment affect offspring.

5. demonstrate a willingness to re-evaluate existing ideas as a result of obtaining new information.

   Sample Indicators:

   a. refine previously developed mental models about an issue on basis of new information received.
   b. evaluate new technological applications in terms of the quality of life it will produce;
   c. implement a plan to assure the best possible future for society after refining concepts about how things are or are likely to be.

6. use scientific and technological information in making decisions about personal concerns.

   Sample Indicators:

   a. explore ways food production technology affects eating habits.
   b. examine the effects of medical technology on the quality of life (consider such issues as individual health, lifespans, living space, employment, feeling of personal worth).
   c. determine the scientific and technological knowledge and skills needed for various jobs.
   d. describe how technological developments (such as robots) have affected the job market.
   e. relate how genetic engineering can affect one's future health and well being.
   f. describe the kinds of genetic data persons should gather before planning a family.

Through science learning opportunities provided in high school, students planning limited post-secondary education should develop the ability to:

7. cite examples of the interdependence of science, technology, and society.

   Sample Indicators:

   a. relate the history of science discoveries to current applications such as antibiotics, vaccines, and crop production.
   b. identify the impact, both good and bad, that the chemical industry has had on society.
   c. debate the positive and negative effects of nuclear energy.
   d. identify sources of pollution (gaseous, liquid, solid, noise, chemical, etc.) and describe how they impact the environment.
   e. discuss the history of transportation and its impact on society.
   f. apply knowledge of current energy sources to our present and future living conditions.

8. communicate technological ideas in written and verbal formats.

   Sample Indicators:

   a. use symbols to express scientific thought, e.g.: chemical formulas, physical laws.
   b. graph information for presentation to others.
   c. explain laws and principles as they apply to specific physical and biological situations.
   d. describe a technological, such as industrial or maintenance, process in sufficient detail for replication by someone else.

SPECIFIC PROFICIENCIES AND PROFICIENCY INDICATORS FOR ACADEMIC HIGH SCHOOL SCIENCE

Through high school learning opportunities provided in the sciences, students planning post-secondary study should develop the ability to:

1. safely use appropriate technology to extend the senses.

   Sample Indicators:

   a. properly use appropriate equipment when examining biological specimens, rocks, stars, etc.
   b. select and properly use appropriate instruments to measure temperature, pressure, voltage, amperage, light intensity, pH, radiation, magnetic fields, etc.
   c. assemble appropriate instrumentation when analyzing materials and systems.
   d. use the computer to collect, retrieve, organize, and transmit data.
   e. observe appropriate safety precautions when doing laboratory and field investigations.

2. access reliable information from any area of pure and applied science.

   Sample Indicators:

   a. access a variety of reliable data-bases.
   b. refer questions to appropriate resource persons.
   c. use library reference skills.
   d. require appropriate evidence of the validity of any information used in scientific studies, technological designs, or decision making.

Through high school learning opportunities provided in the sciences, students planning post-secondary study should develop the ability to:

3. use empirical data to formulate, support, or question generalized statements, including the laws, theories, and principles of science.

   Sample Indicators:

   a. generalize results of laboratory observations.
   b. formulate generalizations from acquired information.
   c. analyze data to support or question published reports and proposals.
   d. explore the effect of new data on currently held conclusions, including both those found in the literature and personally generated.
   e. detect and apply regularities, order, and/or periodicity in gathered data to predict future events.

4. apply scientific knowledge and processes to the resolution of complex problems and issues;

   Sample Indicators:

   a. propose designs for a variety of communication systems using both wave and particle motion concepts.
   b. evaluate the consequences of implementing a proposed industrial chemical procedure based on knowledge of the periodic table, bonding theory, acid-base interaction, oxidation-reduction, solubility laws, etc.
   c. extrapolate existing data to predict events such as the time and location of earthquakes, changes in coastlines, world food supply, world resource reserves, evolutionary changes, etc.
   d. explain how knowledge of energy flow in the hydrologic cycle, photosynthesis, the Kreb's Cycle, etc. can effect the solutions one might propose for world energy or food problems.
   e. predict future conditions based on exponential relationships; e.g.: radioactivity, growth curves, population.

Through high school learning opportunities provided in the sciences, students planning post-secondary study should develop the ability to:

5. recognize that scientific knowledge is tentative, self-corrective, and visionary.

   Sample Indicators:

   a. explain the role of key personalities, episodes, discoveries, and inventions in the development of scientific generalizations and technological advances.
   b. draw time-lines to illustrate the sequences of events leading to various scientific and technological breakthroughs.
   c. present case histories of various scientific or technological advancements.
   d. describe how various scientific understandings and beliefs have changed over time.
   e. identify past scientific, medical, agricultural, and technological ideas and/or procedures which are no longer considered valid.
   f. project future modifications in resource utilization, production methods, genetic engineering, etc. which may result from recent discoveries.
   g. identify questions still requiring answers.

6. use scientific and technological information in developing personal viewpoints, societal decisions, and career plans.

   Sample Indicators:

   a. use scientific information and processes in selecting items for personal purchase.
   b. examine the viewpoints of political action groups, public figures, or political platforms on key scientific or technological issues.
   c. describe the kinds of reviews research results should receive before they are incorporated into a manufacturing process.
   d. assess possible careers in science and science related fields.
   e. identify the specific science training required for entry into various careers.
   f. discuss the ethical issues that should be considered in providing genetic counseling.

Through high school learning opportunities provided in the sciences, students planning post-secondary study should develop the ability to:

7. illustrate the interdependence of science, technology, and society.

   Sample Indicators:

   a. project the cost of solving and managing a local pollution problem.
   b. explain the impact of new products such as insecticides, food substitutes, food additives, new medicines and drugs on life-spans, population problems, and natural resource reserves.
   c. project possible problems associated with our ability to control nature (i.e. through genetic engineering, etc.).
   d. identify and explain problems associated with energy production from fossil fuels, nuclear energy, etc.
   e. project the impact of the information age on jobs, the economy, lifestyles, etc.
   f. predict world leadership roles for various nations based upon their commitment to research and its tehnological application.
   g. examine how modern lifestyles are dependent upon past scientific discoveries.
   h. discuss the pros and cons of making wider use of automation and robotics in industrial and commercial processes.

8. communicate information on scientific and technological issues.

   Sample Indicators:

   a. organize and display data in the form of charts, graphs, or other visuals to communicate information.
   b. explain scientific theories, laws, or principles orally, in writing, graphically, or with models.
   c. record experimentally acquired data to the precision appropriate for the measuring instrument utilized.
   d. provide an intended audience with appropriate evidence of the validity of a report being prepared on a laboratory experiment, a field investigation, or a literature search.
   e. plot data in order to detect trends, perceive discrepancies, and make predictions.
   f. report on an experimental procedure in sufficient detail for its replication to verify findings.

RECOMMENDATIONS

Dear Indiana Educator:

As you implement the Indiana Science Proficiency Guide, you are encouraged to suggest improvements. You may use this form to submit your suggestions.

Thank You.

****

Part A: SUGGESTED ADDITIONAL OR REVISED PROFICIENCY.

1. Proficiency List-06____ Prof # __ Suggested Wording: _____

_____

_____

2. Proficiency List-06____ Prof # __ Suggested Wording: _____

_____

_____

Part B: SUGGESTED ADDITIONAL OR REVISED PROFICIENCY INDICATOR.

1. Prof & Indcr List-06____ Prof # __ Prf.Indicator __ Suggested Wording:

_____

_____

2. Prof & Indcr List-06____ Prof # __ Prf.Indicator __ Suggested Wording:

_____

_____

Part C: OTHER SUGGESTIONS AND COMMENTS.

_____

_____

_____

Return to:

Science Consultant
Center for School Improvement
and Performance
Indiana Department of Education
Rm. 229, State House
Indianapolis, IN 46204

F86SPG

Submitted by:

Name_____

Grade(s) Taught or Superv'd _____

Sch. Corp._____

County _____ Date __/__/__